Performance-Based Business Environment

PBBE

Performance Based Product Definition Guide

JOINT AERONAUTICAL COMMANDERS' GROUP

JACG

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National Aeronautics and Space Administration
Federal Aviation Administration

Performance-Based Product Definition Guide

SUMMARY OF CHANGES

At the Joint Aeronautical Commanders' Group 23 Jan 97 meeting, the JACG endorsed an approach to "stand up" a performance-based business environment within the aviation business sector. The 23 Jan 97 baseline document was approved by the JACG, with the proviso that some clean-up changes occur, including more direct mention of Open Systems concepts. The clean-up revisions are complete and this document is the new baseline. The document's endorsement date remains 23 Jan 97.

Major changes (since the 23 Jan 97 baseline) incorporated into this document address the relationship between the performance based product definition process and open systems based business. Additionally, this document incorporates changes resulting from the "horizontal review" across the set of PBBE documents conducted during the week of 10 Mar 97.

A World-Wide-Web site includes additional information on this and other PBBE "how-to" documents. Access the site through the JACG home page at:
http://www.wpafb.af.mil/az/jacg/index.htm

OPR: ASC/EN (Mr Gary VanOss DSN 785-9293)
Approved by: JACG/Aviation Engineering Board (Mr Gary Adams, ASC/EN**)**

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1.0 PREFACE.

This document describes the basic tenants of Performance Based Product Definition. It describes the role of specifications, standards and technical data in support of a transition from current and past practices to a Performance Based Business Environment (PBBE). Overall, the PBBE has been developed for the aviation business sector to move the acquisition process more toward models that have been successfully implemented in the commercial sector. The intent is to provide more flexibility to contractors in defining and implementing innovative and cost effective solutions to weapon system requirements.

Product definition is an important part of the systems engineering process. Military systems are complex, costly, and must operate in severe environments. They require a disciplined process to specify customer performance requirements, allocate and translate these requirements into specific product designs, and then qualify, produce, and sustain these products. Past practice was based on three basic principles. First, the long term sustainment was based on government control of the detailed design with replenishment spares and component repairs/overhaul dependent upon a strict build to print. This principle served well in the past when product lives and the rate of technology advancement were more consistent. Second, the development strategy was based on early government control of allocated and product baselines with significant government involvement in and control of the design and test of products. Third, the government maintained significant influence and control of the design solutions through the imposition of detailed product and process specifications and standards.

As a result of the 29 June 1994 Secretary of Defense Acquisition Reform Memorandum, the product definition process is being reshaped to be performance based with the objective of achieving improved efficiency and lower cost. Under this new process the government intends to control only top level product performance requirements. Government control below the top level will be implemented only when the sustainment plan for the product, a technology insertion strategy, or a program risk management strategy justifies the added government involvement (refer to the integrated performance based business environment guide). This approach will require the contractors to be responsible for the flow down of requirements and product definition such that the design may be efficiently qualified, produced, and supported. The resulting benefit to the contractor will be the freedom to exercise greater authority and autonomy in the design, production, and support processes. This flexibility will be a key to improving efficiency. DoD systems are complex and require significant effort and cost to qualify and requalify. The DoD can expect weapon systems to be in the inventory for many decades, greatly exceeding original plans. Efficient technology insertion via the use of open systems architectures and flexible support concepts will be required to sustain systems and react to changing mission requirements as these systems are extended. In many areas, the technology base will undergo rapid change. This will impact development, production, and sustainment since many products will not have stable or long term market availability. This phenomenon, coupled with the fact that the DoD is no longer the major market force in many areas (e.g., electronics, materials) will result in greater DoD dependency on commercial products and processes. Finally, aerospace companies will face increased global competition and must have processes and disciplines that they manage and control to remain competitive. Implementation of the reshaped product definition process will provide the technical basis for procurement and business strategies that exploit technology and attain best value

solutions. These business strategies will include build to print solutions where cost effective, modified build to print solutions to allow companies to compete on their best practices, and Form, Fit, Function, and Interface (F^3I) solutions that allow industry to react to technology change with greater cost avoidance than past practices.

It must be recognized that the Performance Based Business Environment which this guide supports represents an end state based on world class customers and suppliers, and the full benefit of the strategies defined can only be achieved when implemented during the earliest stages of the program. Current programs span the full spectrum of program phases, degree of success, and external constraints. Explicit guidance for application of the principles described in this guide to existing programs would be impossible. Rather, the following general guidance is provided to assist program personnel. First, take the long term view and consider the global picture. That is, don't always expect immediate pay back or savings; look to the full life cycle and consider the intangible benefits of a more balanced sharing of authority and responsibility. Second, understand the objective of any changes being considered, and the benefits that are intended to be achieved. Third, recognize that some additional risk is not necessarily bad, so long as the risk is understood and manageable.

This guide recognizes that Performance Based Product Definition is a continuous process and is impacted by a number of considerations. As such, this guide is structured consistent with the following:

- The focus of this guide is development, production, and sustainment. It is, however, applicable to pre-EMD efforts as well.
- Product performance requirements will be used as the basis for all development contracts, and may also be used for production and sustainment. The top level, government controlled specification will be limited to requirements derived from User needs and program constraints. Requirement allocation and product definition below the top level of the contract specification will be the supplier's responsibility and will be under supplier control.
- Build to print procurement and sustainment is a viable PBBE option where it proves to be cost effective from a life cycle perspective.
- The contractor is responsible to define an integrated, incremental verification approach.
- For other than strict build to print business decisions, the Government does not intend to put processes on contract. There may be some exceptions and these should be made on a value added/cost-benefit basis.
- Tasking statements should not be included in product performance requirements.

This guide is organized to address the transition to performance based product definition. As such, it provides sections on current practice, transition, performance based approach and procurement alternatives all written primarily from a development perspective. This is followed by a section covering the implications for spares reprocurement, maintenance and repair focused primarily on sustainment and support. Finally, it addresses access, control, and delivery of information and ends with a brief discussion on Joint Service Guide Specifications.

2.0 INTRODUCTION.

The Performance Based Business Environment encompasses all aspects of development, procurement, and sustainment (e.g. maintenance, reprocurement of replenishment spares and depot level repair) of weapons systems. It incorporates the major elements of acquisition reform and provides for the conduct of programs based on management and product requirements defined in performance terms which describe their essential characteristics. The six main features of PBBE, relative to specifications, standards, and product definition data, are: (1) performance based requirements that are incrementally verified throughout development; (2) the discipline to define and organize the required development, design, fabrication and sustainment information at all levels of the product definition hierarchy; (3) the discipline to maintain requirements and design traceability, and completeness and consistency of the product definition throughout the weapon system's development, production, and support phases; (4) supplier control of the development, detailed design, and technical definition to the maximum extent possible; (5) supplier use of their own company/facility production processes; and (6) enhanced opportunities for incorporation of advanced technology.

In execution, it is imperative that the following basic principles be recognized and understood:

- A capable systems engineering process is required. The final output of this process should be a product definition which describes the end items at all levels of the product definition hierarchy down to the lowest reparable level in the supplier chain (except in those cases where COTS/NDI is utilized) regardless of the fact that in most cases the government will eventually control and/or take delivery of only a limited portion of the data. This is an enabler to facilitate delivery of products which meet all performance, cost, and quality requirements, and to facilitate future support requirements.
- Contractual language between government and supplier will be written in performance based terms. The government encourages "prime contractors" to communicate with their suppliers in performance based terms.
- The information used for product maintenance and support is derived from the product definition information.
- Mandated use of military specifications and standards will be limited, except for required interface standards. These documents have been utilized in the past (either by reference in the Statement of Work or in specifications) to convey requirements for products and/or their verification. Essential performance attributes of these documents are to be incorporated as appropriate in a product's requirements definition.
- Suppliers demonstrating the capability for self-governance will be given greater authority and responsibility.
- The degree to which these principles will be applied to Non-Developmental Items (NDI) will be based on a cost benefit analyses.
- Application of these principles is not intended to imply the exclusion of proprietary data rights. The acceptability of proprietary products or processes will be based on a combination of cost benefit analyses and risk analyses which address their life cycle application.

3.0 PRACTICES PRIOR TO ACQUISITION REFORM.

The requirements allocation process was often incomplete. Derived requirements at the lower levels of the allocation (specification tree) were not fully developed and controlled and in some cases higher level requirements were simply "passed through" to lower level designs with no further detail or definition. This resulted in "point design solutions" which evolved through trial and error during the qualification process, a lack of understanding of the true design requirements and the critical elements of the solution impacting its performance, and created problems during transition to rate production, support, and spares reprocurement. Frequently, the right information was generated, but not captured and maintained. Thus, it was not available for downstream activities such as sustainment, item management, and technology insertion. Requalification of updated designs has been very costly, involving significant flight testing to verify full functional capability, and inhibits efficient technology insertion for rapidly evolving technologies.

The combination of prescriptive military specifications and incomplete technical data packages resulted in limited flexibility for the government and the contractor in achieving designs which were optimized in terms of performance, cost and development time. This resulted in contractors maintaining separate processes for each contract and limited their ability to incorporate rapidly developing technology during the life of the weapon system, either to improve performance or to enhance supportability as existing parts became obsolete (digital computers, for example). Lastly, highly qualified alternate sources were often precluded from using more efficient or cost effective production and/or repair methods.

4.0 TRANSITION TO PERFORMANCE BASED PRODUCT DEFINITION.

Today's environment will have a major impact on the military services in acquiring and maintaining combat systems. It is important that acquisition reform implementation recognize that many technology areas will be non-stable and rapidly changing. Effective methods to minimize this impact will be required for development, production, and sustainment. Budgetary pressures will demand that weapon systems stay in the inventory for greater periods of time. This may exceed original product design life and may also add or change mission requirements. Further, the DoD faces global competition. It will be essential for the US military to field products efficiently in order to capture today's rapid technology growth and maintain a quantitative cost-capability advantage for sale or lease of US products. As such, the JACG approach to acquisition reform is a quasi-commercial approach intended to reduce costs/resources, enhance cycle time, and improve quality. This approach will require the contractors to be responsible for the flow-down of performance based requirements as well as product design definition, verification details for the design solution, and the manufacturing/support process definition. This is best done through a systems engineering process based on completing and maintaining the "As Integrated/As Installed" product definition with emphasis on qualifying the design for efficient downstream change. Such a process will be an enabler for implementation of open system architectures which facilitate this downstream change. Suppliers will have the responsibility to develop and qualify the design and build the product to meet the

government's top level requirements, using contractor specified and controlled practices and/or industry processes. Additionally, suppliers will have the opportunity to bid for long term life cycle management of the product.

5.0 PERFORMANCE BASED APPROACH.

The performance based approach described in the following paragraphs is a comprehensive framework for product definition and documentation. As such, it covers many elements and activities of the development process, some of which will be under the control of the government customer, and many of which will not. The discussion is meant to convey a complete picture of product definition under PBBE; it does not imply that all elements described will be included in the government-to -prime contract.

For new acquisitions (or major system upgrades), in accordance with current DoD policy, military specs and standards will be used only in very limited applications. Product requirements will be specified in performance based terms, except in those exceptional instances where specific interface requirements mandate the use of a military spec or standard (e.g, MIL-STD-1760, standard for military armament). The contractor thus has increased responsibility and control over processes throughout EMD and production and will be responsible to generate and control the product definition data at each level of the product definition hierarchy. The objective will be to capture the requirements and supporting design and fabrication information in sufficient detail such that any element of a system may be replaced without the requirement for modifying other elements of the system to achieve interchangeability or interoperability (i.e, an open systems approach). To illustrate this concept, changing an SRU (see figure 1) is done ideally without the requirement to change any other elements, both hardware and software, at the SRU, LRU, or system level. In addition, this information may be useful in support of changes to the government's product sustainment or technology insertion strategies. Figure 1 illustrates this process and some of the basic elements of the product definition data which include interface definition (ID) and product acceptance criteria (PAC).

Developing a Performance Based Product Definition requires a disciplined systems engineering process throughout design, verification, fabrication, product acceptance and production process verification. This results in an allocation hierarchy that has complete definition from the system level down to the lowest procurable and/or reparable end item level, e.g., the air vehicle to the actuator. The old two part specification-based practice has not provided the efficiency or level of detail required, especially for technology insertion and modifications or upgrades. An improved discipline is needed at every level below the system level to ensure that the requirements, product, design and product fabrication definitions are complete, consistent, and traceable.

In order to accomplish this, it is suggested that a capable systems engineering process will define multiple categories of information content. It is important that these discrete categories of information relating to the product definition be developed in a sequential manner and documented in the appropriate media. This will achieve efficiency in arriving at the detailed definition of the product to be produced, and will provide the information which will later be required to enable technology insertion, foster competitive supplier business arrangements, and allow flexibility in sustainment and support approaches. It is

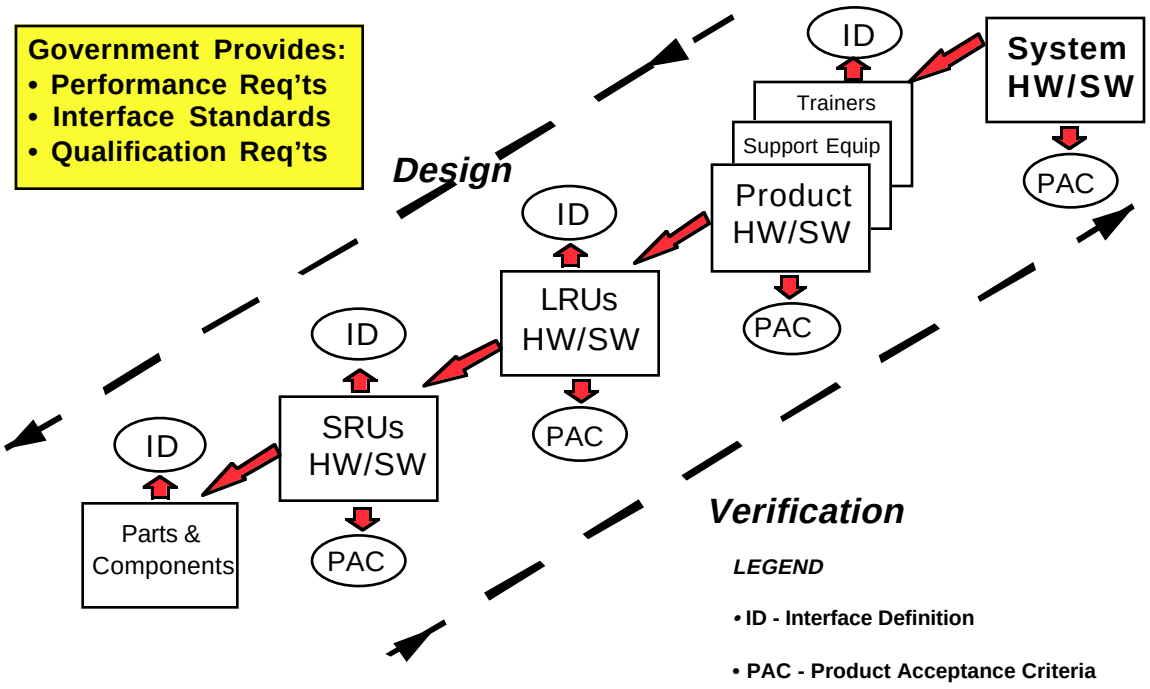

Figure 1. Design and Verification Flow.

emphasized that this approach does not require a prescribed format. Nor does it imply access, ownership, control, or delivery to the government. It must also be re-emphasized that application to Non-Developmental Items must be based on cost benefit analyses. These factors are related to business decisions which are described in the PBBE Guide. The discussion which follows suggests a particular form of the information content as an example of an implementation strategy; however, a particular form would not normally be a contractual requirement between the government customer and the prime contractor. In order to achieve the maximum benefit of the performance based approach it is important that all suppliers in the product hierarchy utilize this basic framework; and it is therefore recommended that contractors adopt this approach.

The categories of information content described above are as follows:

Category 1.— Product Performance Requirements Definition
Category 2 — Product Design Definition
Category 3 — Product Fabrication/Manufacturing Definition

Category 1, the Product Performance Requirements Definition, defines end item functionality and performance. The information in this category is the result of the translation of operational needs into specific performance requirements for the product or system specified in terms relevant to those who will design and produce the product. This definition provides the functional and performance requirements for the product and the basis for qualification. It addresses both hardware and/or software. When this product is provided by a supplier, it would form the performance based product requirements for the contract.

Category 2, the Product Design Definition, defines those elements of the proposed design solution which are critical to achieving the performance requirements defined in Category 1. An example: the Category 1 development definition for a computer requires 10,000 hours reliability, i.e., the functional requirement. The Category 2 product design definition identifies computer chip lead lengths as a key characteristic relating to reliability. As such, the category 2 requires that the computer chip's leads be controlled to lengths of 2 mm's plus/minus 0.5 mm to assure that the stresses due to thermal expansion and vibration do not cause breakage of the leads. This attribute would be determined consistent with the manufacturing capability as well. The Category 2 definition also contains Product Acceptance Criteria (PAC) which define key design attributes to be measured to prove that the performance requirements are being met, thus achieving interchangeability/ interoperability and enabling cost effective technology insertion. These attributes may be specific to the actual design of the end item and/or may be derived from the "as integrated/ as installed" characteristics that the larger system imposes on the end item. As such, the PAC deal with both the functional and physical aspects of the product and define in performance terms, to the extent possible, the key metrology (measurement condition) requirements. This allows downstream procurement to be independent of facilities, manufacturing processes, and specific factory test equipment that were used in the original design verification. This has potential benefits for downstream reprocurement in a rapidly advancing technology arena. It is recognized that some acceptance criteria will be specific to a specific design or process; and these must also be reflected in the Category 2 definition. This introduces the potential for proprietary data. Where this is necessary, the consequences to down stream product management must be considered. The program office's contracting officer and data management personnel should review and advise the program manager on proprietary data issues.

Another important element of the Category 2 definition is the delineation of interfaces. An Interface Definition (ID) is either included within the Product Design Definition or developed as a stand-alone document that is tied to the Product Design Definition by reference. It details the "as integrated/as installed" characteristics of the design, specifies interfaces within the design that are required to achieve the specified function ("horizontal" interface) and specifies interfaces that are required by external elements of the larger system that the function must support ("vertical" interface). An example of a horizontal interface would be the data path within a radar between the receiver and the digital processor needed to calculate terrain height. A vertical interface would be the data path between the radar and the flight control system needed to provide terrain following flight commands. Interface definition must capture: a) the hardware to hardware, b) the hardware to software, and c) the software to software characteristics of the design for both the horizontal and vertical perspectives in order to assure interchangeability/interoperability without the requirement for external compensation. Otherwise, major cost and schedule impacts to requalify will result. For electronics and software this especially includes the physical, logical, electrical, timing and information integrity that may be demanded by the whole system to assure that safety and mission critical requirements are met. Refer to Figure 1 to help in understanding these relationships.

Focusing the Category 2 PAC to achieve technology insertion as well as qualifying the "instant" design is a significant element of the PBBE systems engineering process. This is a clear departure from past practice and is aimed at future cost avoidance through efficient change. The Category 2 definition (which is the result of a comprehensive and capable

systems engineering process) is, in fact, the vehicle needed to establish and verify the requalification (or regression) requirements necessary for efficient design change, and enables the implementation of an open systems approach. It establishes the foundation to support changes in sustainment and technology insertion strategies over the life cycle of the product.

Category 3, The Product Fabrication/Manufacturing Definition, specifies the design solution of the qualified end item. The Category 3 definition contains or references electronic product definition data, detailed drawings, bills of material, etc. and identifies key product characteristics, key production processes and provides the work instructions for fabrication and assembly. The Category 3 definition also contains the production/support process capability requirements and provides the basis for quality assurance. It should be emphasized that this does not imply a requirement to define proprietary processes themselves, only the capability of these processes, specifically in terms of controlling key product characteristics. Some key features associated with the Category 3 definition are:

1) Drawings or electronic product definition data will be production/support level and will represent the current configuration of the item being built. If detailed product definition data are anything less than this "as built" configuration, parts may not fit or function properly. Product definition data will be in contractor format. Commercial product definition requirements are well understood; the media of delivery remains a customer requirement and will be specified by the procuring activity for that portion of the total product definition package which is deliverable.

2) Contractor process specifications will be used rather than military specifications or standards when available. It is important to capture within the product definition data the key process capability requirements in order to have traceability in the design requirements and enable downstream flexibility in procurement options for spares and sustainment. Once again, this introduces the potential for proprietary data.

3) Finally, those key characteristics captured in the product definition data must be presented using typical industry approaches which are currently in use (such as special tolerances, notes, unique materials, etc.) or captured in a manner which allows for easy identification for procurement and sustainment requirements. This completes the flow down of performance and process requirements and interfaces. These are all linked and traceable by the product definition data, from top to bottom of the product definition hierarchy.

The Acquisition Model, Figure 2, describes a framework for producing product definition data for a new program, along with the government/contractor and contractor/supplier relationships necessary to achieve the benefits of a Performance Based Business Environment. The Government provides top level system performance requirements. The contractor allocates requirements for all lower level elements of the system through a systems engineering process and provides these allocated performance requirements to suppliers. Product performance specifications with lower level suppliers are used as the basis for the contracting at that level. Suppliers, in turn, translate the allocated end item product performance requirements into Category 1 product performance requirements definition and develop Category 2 product design and Category 3 product fabrication definitions (note that logistics performance requirements such as reliability, fault detection

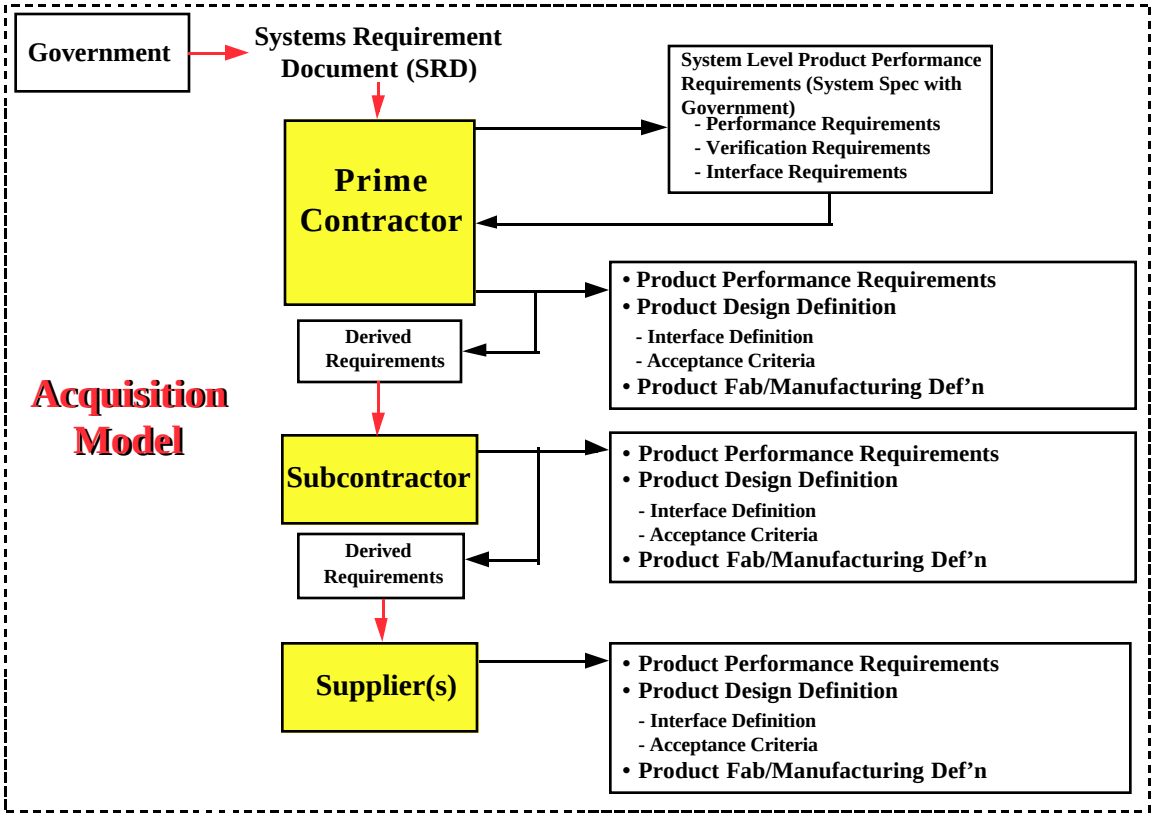

Figure 2. Acquisition Model.

and isolation, etc. are included in this process). It is critical that the product definition process be complete at all levels and that it be maintained current as the design evolves over the life of the system (this evolving design is being experienced on most of our weapon systems).

A complete product definition data package is a prerequisite to enable interchangeability/ interoperability and to allow for the use and incorporation of commercial technology when appropriate (objective of open systems). Additionally, it would also form the basis for the design, verification, production, and support of safety critical parts and components and would delineate the special requirements which must be satisfied for this class of parts. It also provides an ideal framework for the incorporation of product acceptance via process control rather than acceptance test or inspection.

The above discussion pertains primarily to the development phase. A more complete treatment of the multi-category product description concept as it pertains to the procurement and sustainment phases will be presented in later sections.

6.0 PROCUREMENT ALTERNATIVES.

The DoD purchases a wide range of products in small quantities to very large quantities. As such, it requires some flexibility in matching the acquisition approach to the product in order to achieve the most cost effective procurement action. For military aero-space systems three procurement alternatives are available:

1. Build-to-Print (BTP)
2. Modified Build-to-Print (MBTP)
3. Form-Fit-Function-Interface (F^3I).

"Build-to-print" is the approach that exhibits the least flexibility. It utilizes a fabrication agent who is provided with a complete product definition package containing the key product performance characteristics, product acceptance criteria, product design detail and manufacturing processes. The fabrication agent must build the product exactly as specified (using the specified processes or ones demonstrated to be equivalent). The Category 3 data is the essential information for implementing BTP.

The second alternative is "modified build-to-print". It is similar to build-to-print in that it also utilizes a fabrication agent who is provided a product definition package containing the key product performance characteristics, product acceptance criteria and product design detail again all specified. However, the fabrication agent now has been given the flexibility to change the manufacturing processes to produce the product so that cost and/or schedule benefits can be realized while maintaining key performance attributes. Depending on the demonstrated capability of the builder, these process changes may or may not require the prior approval of the customer. To implement modified build-to-print Category 3 data is required, less the process details (the process details may be provided for reference purposes). Category 1 and 2 data may also be provided since they are valuable to insure that manufacturing process selection is consistent with the product's end use requirements.

The third acquisition alternative is "Form, Fit, Function and Interface". It utilizes an agent with design as well as fabrication capability (which may or may not reside in the same organization). In this case, product performance characteristics, interfaces, and product acceptance criteria are specified; but there is flexibility for the supplier to provide any design which meets performance requirements. The supplier is also responsible for defining and executing the manufacturing processes to produce the design. This facilitates efficient technology insertion, and is most applicable where evolving technology can provide benefits. The end item performance and interchangeability must be verified to be unaffected by the design and/or process change. Changes must consider total life cycle cost impacts as part of the overall decision process, including any impacts to support. Again, prior customer approval of changes may or may not be required depending on the demonstrated capability of the supplier.

To implement a F^3I reprocurement, both the Category 1 and 2 data are required, and Category 3 data may be required depending upon the extent to which the design is to be altered. The supplier will need to develop new Category 3 data consistent with his design solution and/or build process(es). Category 2 data may need to be modified as well.

It is extremely important to understand the necessity for controlled, complete, and up-to-date product definition data packages at all levels of the product hierarchy is the same regardless of which acquisition alternative is selected and regardless of which organization (e.g., government, prime contractor, sub contractor or vendor) administers the build/buy actions and activities. The product definition data package is the technical foundation for a cost effective and efficient Performance Based Business Environment and is applicable for new builds, initial spares and reprocurement spares. The choice of implementation alternative (build-to-print, modified build to print or F^3I) is a business decision which must

be based on consideration of overall program factors such as costs, expected benefits, schedule, technical complexity, risk, support strategy, and any additional mandated program constraints. Use of different alternatives may be desirable for different portions of the same program; however, all are acceptable under the overall umbrella of the performance-based approach.

7.0 IMPLICATIONS FOR SPARES REPROCUREMENT, MAINTENANCE AND REPAIR.

The procuring activity must make early, strategic decisions regarding the support concept to be employed and the documentation which must be purchased to enable the chosen support concept to be implemented (see the integrated PBBE guide). If the government wishes to employ organic support down to the lowest reparable part level for a given element of the weapon system, it must incorporate in its contract with the prime appropriate provisions to take delivery of the complete product definition data package as well as provisions to update that package to reflect the latest configuration. An option which allows the government to take delivery without taking control could be to provide access to the required data on a fee-for-service basis. This could also address the need to maintain the currency of the data. Conversely, for some elements of the system (particularly those in which rapid technology changes are anticipated) a better approach could be to buy spares to support the system at a higher level of assembly, allowing supplier(s) the flexibility to change the design and/or production processes associated at that level while leaving the essential performance characteristics and the interface unchanged (hardware-to-hardware, hardware-to-software and software-to-software). This is particularly appropriate in a two-level maintenance environment which is anticipated to exist in the future.

The range of support options implies a broad range of data requirements. For Contractor Logistics Support (CLS) using the F^3I approach, the government would only have to take control and delivery of Category 1 product performance requirements data. For CLS using the BTP or MBTP approach, the government has the option of taking control and delivery of the Category 2 and 3 data, or taking periodic delivery and "ownership" to meet immediate needs. This applies whether the support is at the end item level or at the LRU/SRU level. For organic support, the same basic options are available, though historically, it has been limited to BTP.

The remaining question concerns the approach to be followed in reprocuring spares for existing systems which were not developed and purchased using the performance based acquisition approach, and for which complete product definition data may not exist. In this case the potential benefits to be realized by allowing contractors furnishing replenishment spares the flexibility to make design and/or process changes must be weighed against the costs of acquiring the requisite data. Clearly, in many cases, continuing to employ a build-to-print approach at the component level will make the most economic and business sense since significant data generation and/or requalification costs would more than offset expected benefits. On the other hand, in some cases it may be advantageous to employ a "reverse breakout" strategy wherein spares reprocurement is accomplished at a higher level in the system hierarchy (e.g., subassembly or LRU level) than was done previously, after

first taking action to generate the required data, including complete product acceptance criteria and definition of all critical interface and performance requirements.

The choice of approach for buying replenishment spares is a business decision which must be made by each program office or support element. Options include those comparable to current practice (i.e., build-to-print) as well as those which grant considerable latitude in approach to the contractor (modified build-to-print and F^3I). All are contained within the overall framework defined by Performance Based Business Environment for new and existing systems.

8.0 PRODUCT TECHNICAL DEFINITION ACCESS, OWNERSHIP, CONTROL, AND DELIVERY.

The basic premise for the Performance Based Business Environment is to provide the best value solution for the life cycle of a product. The discipline to develop the complete product definition is essential to enable flexibility in development, production, and sustainment. With the high current cost of requalification of DoD weapon systems, information maintenance is not viewed as a cost penalty when it facilitates efficient technology insertion. Rather, it is a necessity. The real time nature of modern weapon systems is compounded by the sheer complexity of what is possible using digital, programmable designs. Functions become dependent on host hardware intricacies to such an extent that minor variations in either hardware or software can lead to erratic operation. Where safety is involved, this can be deadly. Without knowledge of the design decisions, critical margins, and rationale behind the build up of a function vis-à-vis hardware and software roles, the cost to change and requalify will remain out of control. Ultimately, both the government and industry are dealing with risk management. Greater contractor freedom over design decisions, when and what to change, and the opportunity for life cycle management do not come free. The complete product definition is the foundation, the minimum level of capability for a performance based acquisition approach.

The PBBE systems engineering process will lead to the development of product definition data as described in paragraph 5. The exact composition and media for the product definition information will be under contractor control and management to the extent it satisfies contractual data delivery requirements. Some of this information may be identified in the contract as deliverable to the government. The amount of deliverable information and the format for delivery will be specified in the contract. It should reflect the government's long term plans for technology insertion, support and sustainment, as well as program risk considerations (see the integrated PBBE guide). Where information is not deliverable, the government may want access to the contractor's product definition data. In both cases, the contractor must maintain the information. If other than contractor format is required, this will have to be specified and included in the cost of the contract. A general rule that may be applied is to delay government control of the product definition data until needed for implementing program strategy. Control of Category 1 data should normally not be accomplished until the design is thoroughly verified and stable. This may be after initial production. Similarly, government control of Category 2 and 3 data, if applicable, should normally not be implemented until production capability has been similarly verified and stable.

The contractor is free to utilize the best choice of alternatives (i.e., F^3I, modified build-to-print, or build-to-print) executing business relationships with his external and/or internal suppliers using one or more of these alternatives (in practice, some combination of each would likely be employed for different elements of a complex system). The degree of freedom granted to each supplier to make unilateral changes to design and/or manufacturing processes would depend on an assessment of the demonstrated capability and process maturity of the supplier. Likewise, the freedom of the contractor to make similar product and/or process changes would be described in the contractual arrangement with the government customer.

9.0 IMPLEMENTATION.

The implementation of a robust product definition process in a performance based business environment has as its basis the maximum utilization of non-prescriptive statements of product capability. In new and modified contracts, interface standards, either commercial or military unique, are acceptable for use. It is also acceptable to use general consensus product specifications/standards, either military or commercial. These generally represent commodity items, e.g. aluminum alloys and aerospace quality fasteners.

Other military standards such as the manufacturing and process standards have been canceled. These include standards such as those for corrosion and soldering, to name but two examples of many possible. In the past these standards were applied via call out in the statement of work or in contractual specifications. It is important to understand that while the use of these prescriptive standards has been drastically curtailed, these documents contain in many instances valuable information which ought not to be lost. Military specs and standards often reflected a particular solution to a problem which was identified at great cost or painful experience, and as such, contain embedded performance and verification requirements resulting from these “lessons learned”. The challenge in defining product requirements in performance based terms is to reflect the experience gained in the past without doing so in a manner which dictates a singular solution and/or process.

In past practice, specifications applied to development contracts have concentrated solely on the performance of the intended production articles. It is essential to recognize that the end product of development is the definition and documentation which describes the production article(s) and <u>not</u> the production article(s) itself. Thus, essential performance attributes governing development process aspects such as configuration and interface management also need to be incorporated into the structure and content of performance based requirements.

10.0 JOINT SERVICE GUIDE SPECIFICATIONS (AVIATION).

The performance based requirements concept described herein is being implemented for the aviation sector in a series of Joint Service Guide Specifications (JSGS) developed under the auspices of the Joint Aeronautical Commanders Group (JACG), Aviation Engineering Board (AEB). They are built around the Product Definition process described herein and provide representative performance requirements and verification criteria. Although not necessary for the successful implementation of the PBBE systems

engineering discipline, the guide specifications will be helpful in understanding the government's expectations based on prior experience and lessons learned. A guide specification is a generic specification for a class of like end items which identifies, but does not assign values to the complete set of performance parameters which must be achieved. Requirements are stated in terms of required capabilities and must be design independent. Each guide specification includes a handbook that documents, for each requirement and associated verification criteria, the rationale for the requirement and verification criteria, guidance on using/developing values for the requirements and criteria, and lessons learned. The JACG has established an executive board (comprised of the AEB Service Principals) that is chartered to manage the development and coordination of JSGSs within the aeronautical sector. The AEB has defined a requirements allocation tree applicable to the aviation sector as shown in Figure 3. These documents will be a basis against which requirement flowdowns can be established.

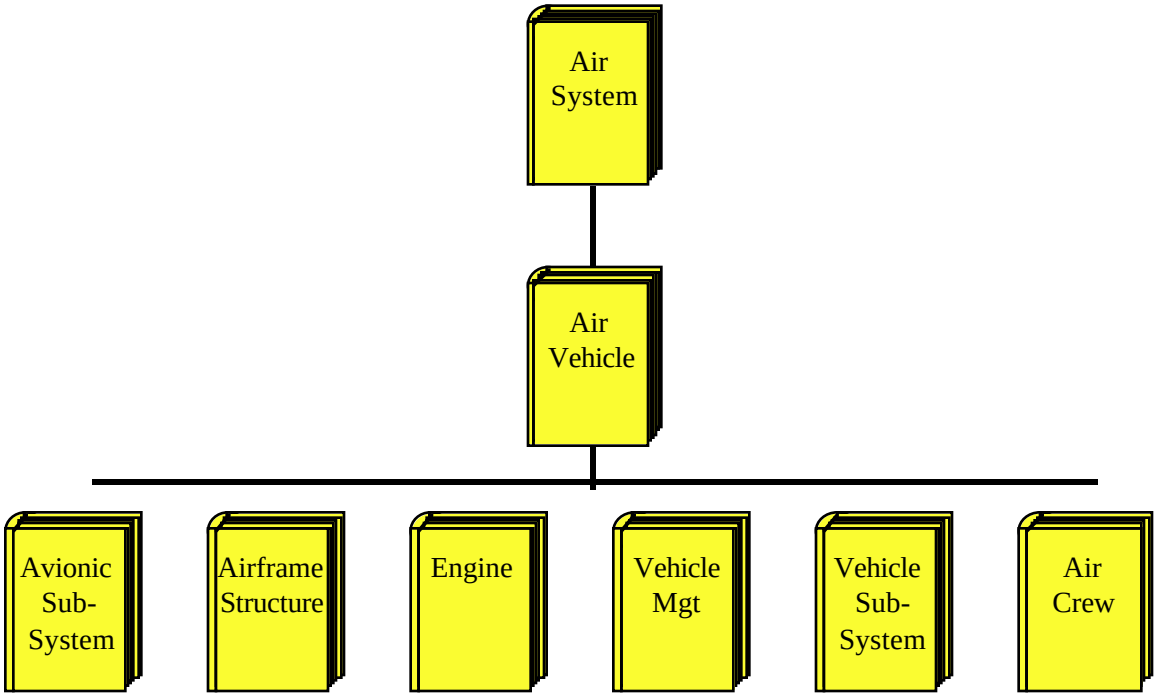

Figure 3. JSGS Aviation Specification Tree

11.0 SUMMARY.

The Performance Based Product Definition provides the Government and its Suppliers maximum flexibility, allowing the decisions for development, procurement of production articles, and post production support and sustainment to be programmatic and based on the business factors making the most sense for each specific case (including reprocurement decisions at the lowest repairable component level).